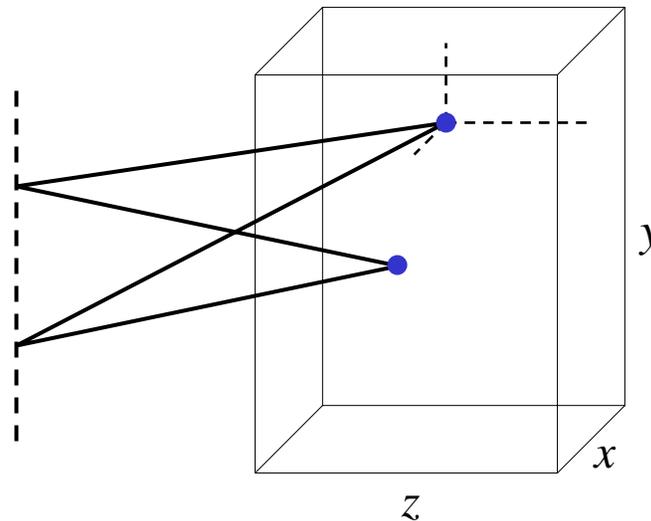


A role for MOEMS and micro-optics in image guided intervention

David Dickensheets
Electrical and Computer Engineering
Montana State University

*Image-Guided Interventions (IGI) for Medical Applications Workshop
May 13-14, 2004*

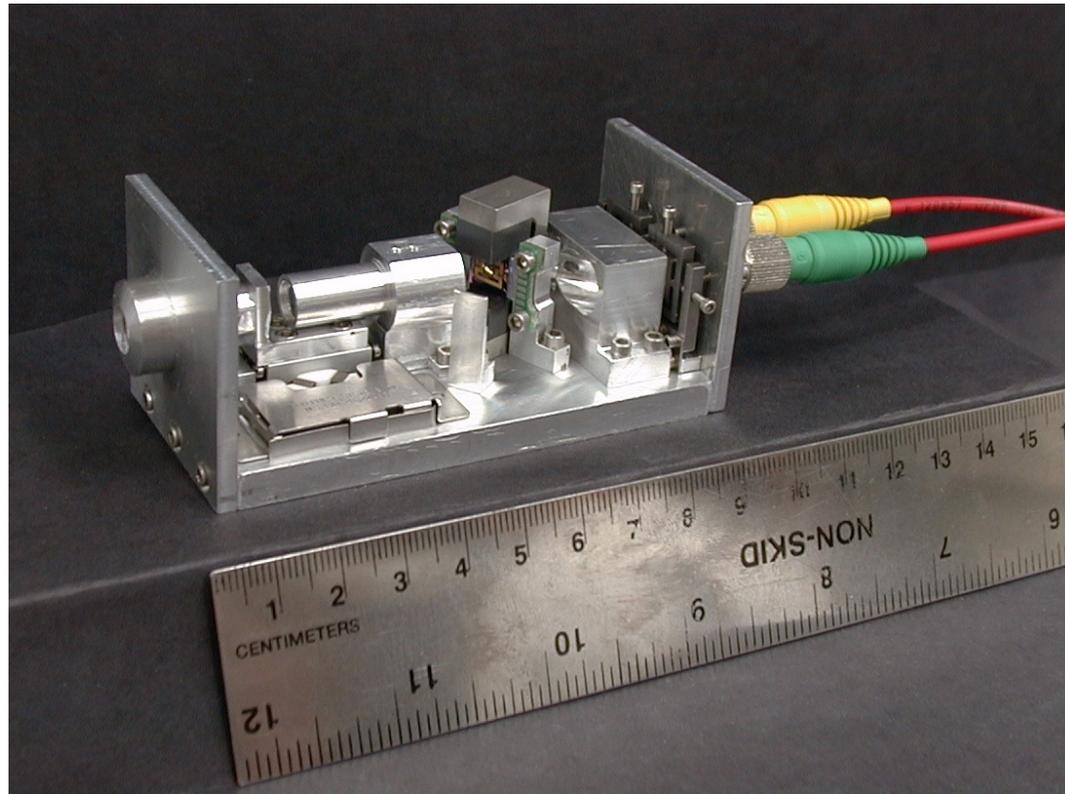
Subsurface and Volume Imaging Requires 3-D Beam Control



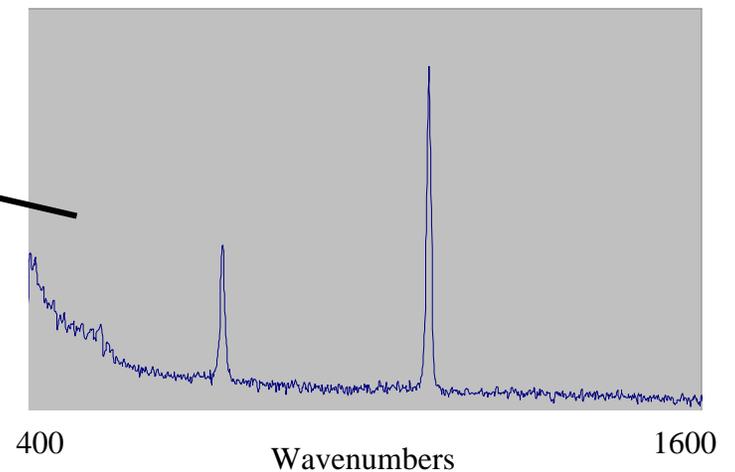
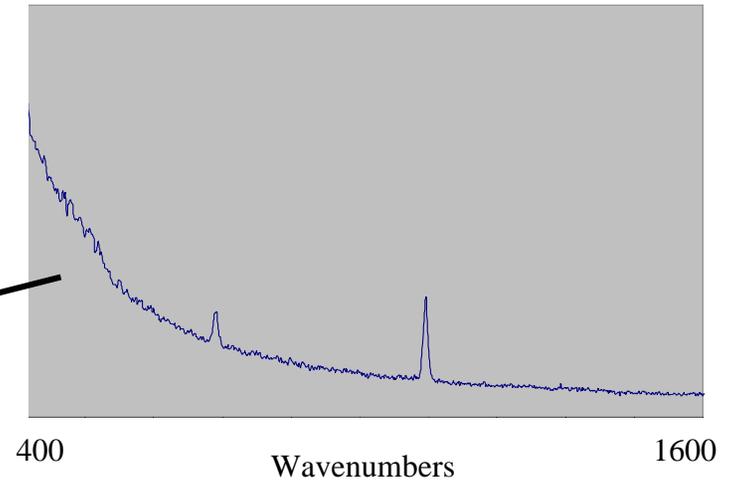
- Tip-tilt mirrors for beam scanning
- Deformable mirrors for focus control

Application to confocal microscopy and OCT

Example of MOEMS-enabled imaging: CMaRS Confocal microscope and Raman spectrometer



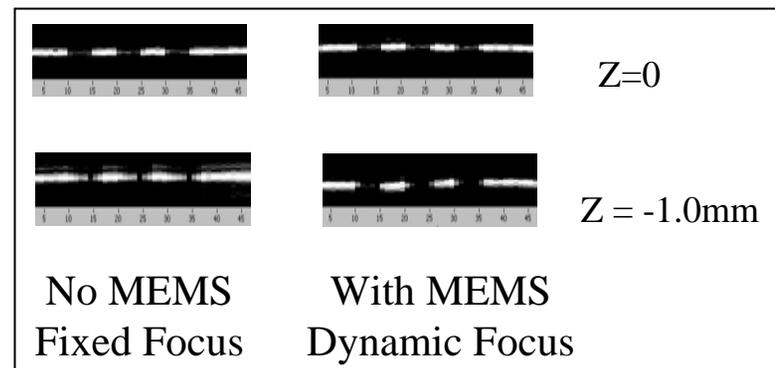
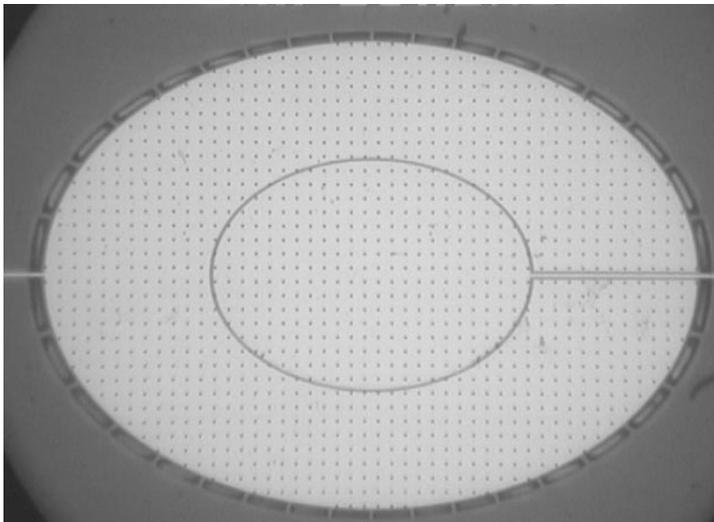
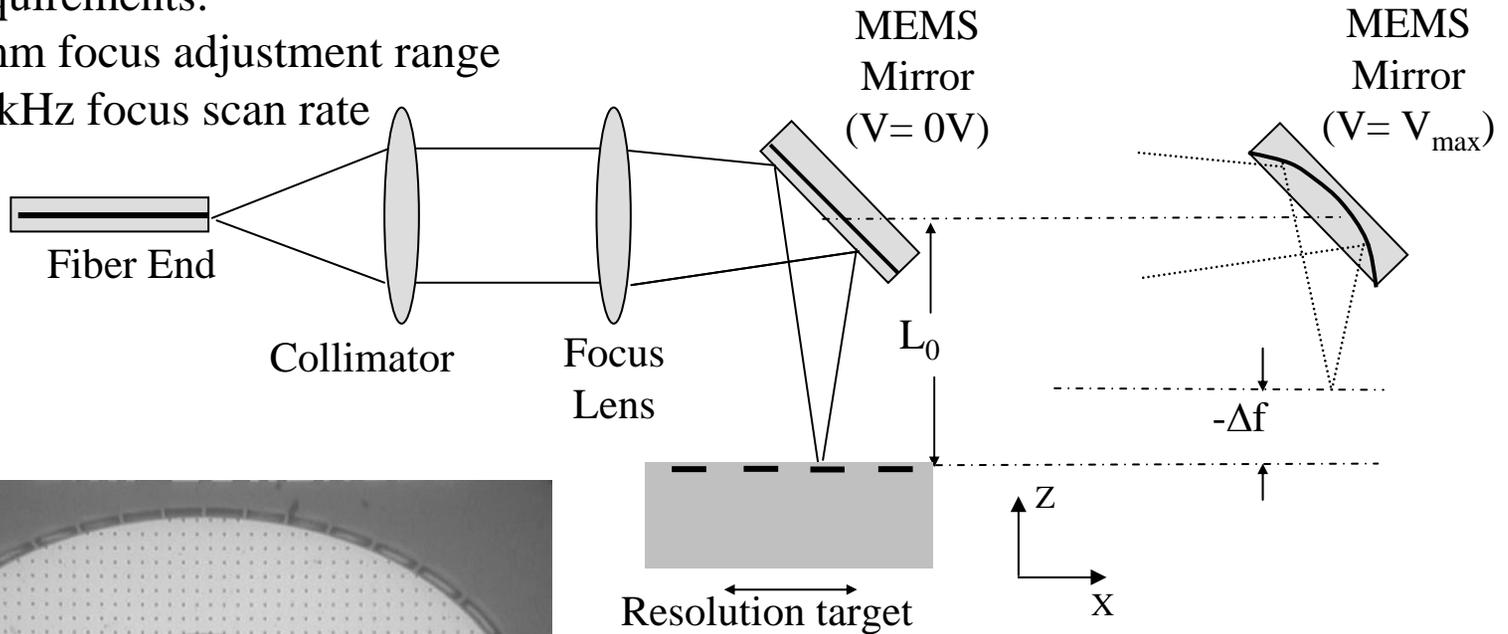
Calcite Image and Spectra



Demonstration OCT probe with MOEMS dynamic focus mirror

Requirements:

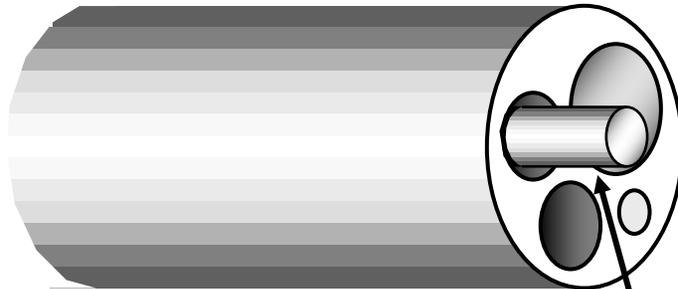
- 1mm focus adjustment range
- 8 kHz focus scan rate



MOEMS for endoscopic microscopy

Fluorescence confocal laser scanning microscope compatible with endoscopic delivery.

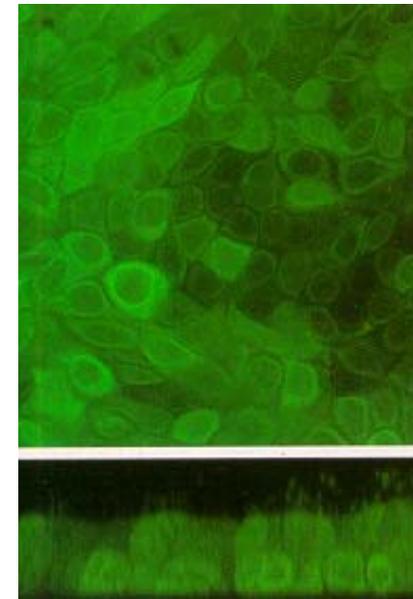
Endoscope for wide-field imaging and biopsy guidance



Fluorescence confocal microscope

en-face image
($x-y$)

depth image
($x-z$)

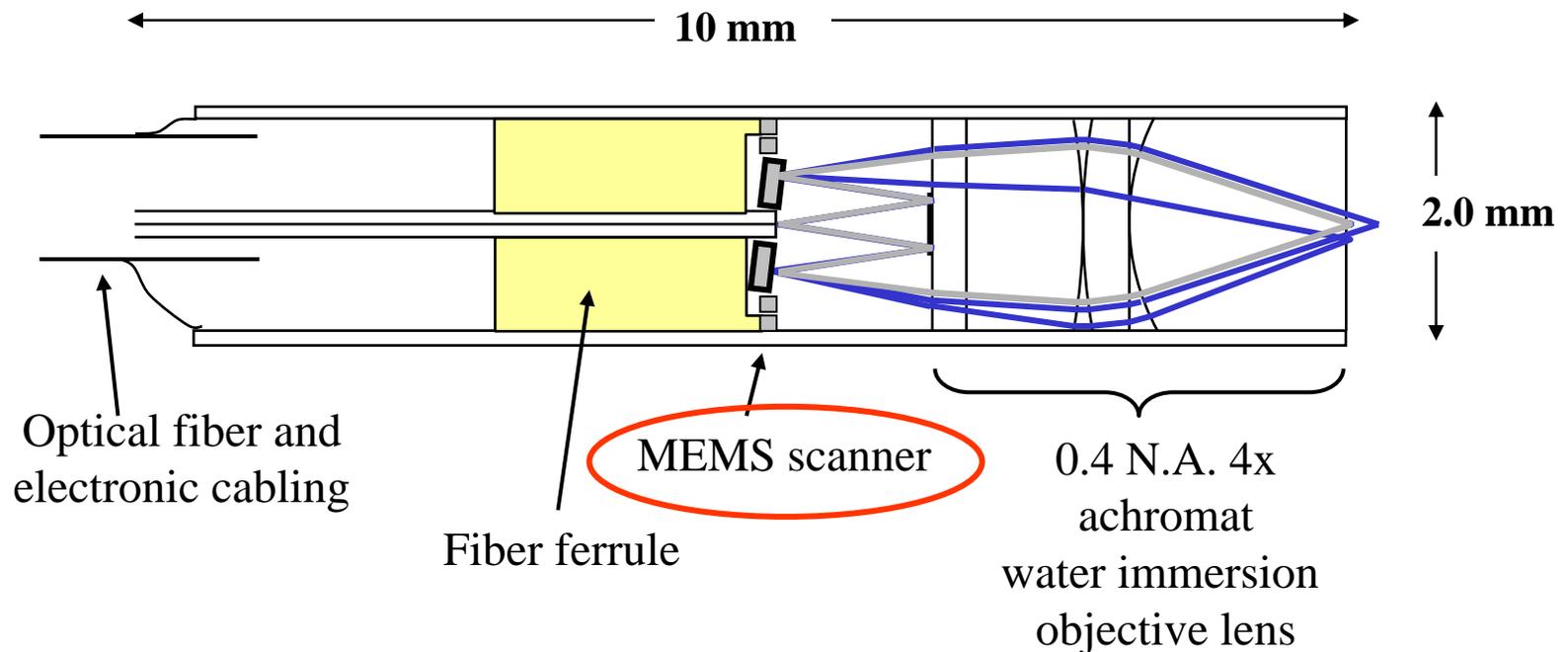


Bronchial epithelial cells in culture, stained by CMFDA

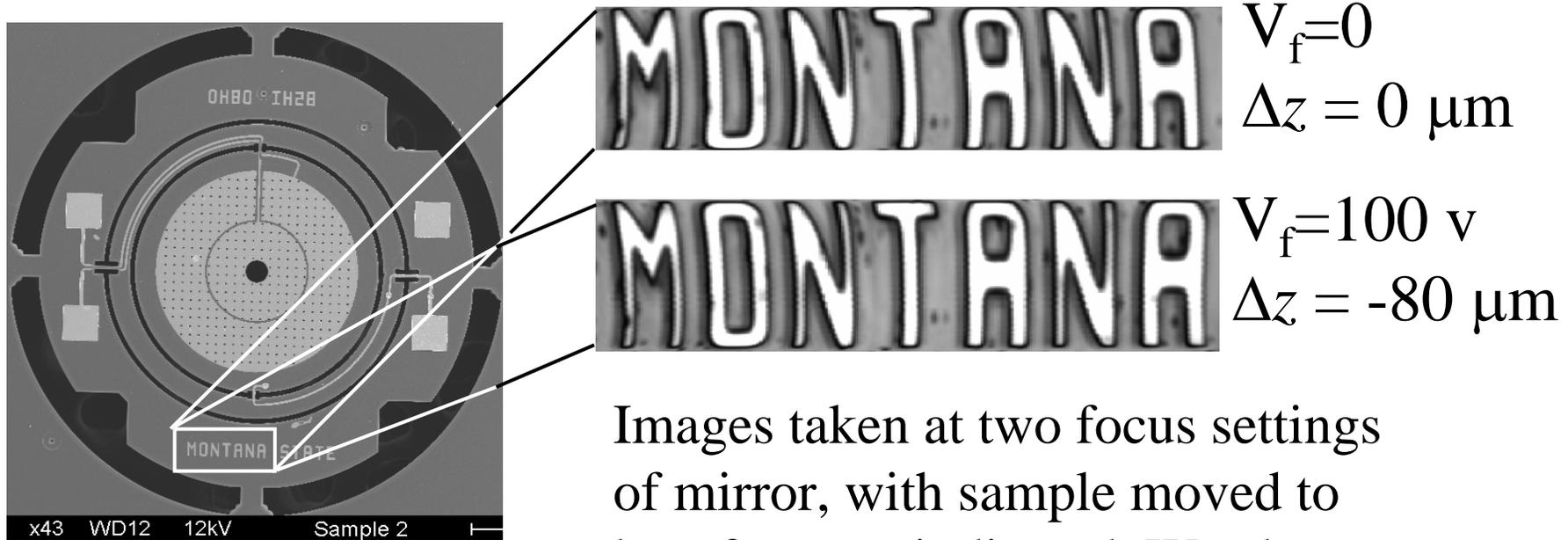
Integrating functionality Enables Compact Instrument Architecture

Combining tip-tilt and focus control:

Next-generation miniature F-CLSM



Images made using 3-D MOEMS scan mirror



Images taken at two focus settings of mirror, with sample moved to best focus as indicated. Word width is $270 \mu\text{m}$. $\text{NA}=0.12$, $\lambda=650 \text{ nm}$.